

ZOOGOER

March-April 1987



Friends of the National



is a nonprofit organization of individuals, families, and organizations who are interested in helping to maintain the status of the National Zoological Park as one of the world's great zoos, to foster its use for education, research, and recreation, to increase and improve its facilities and collections, and to advance the welfare of its animals.

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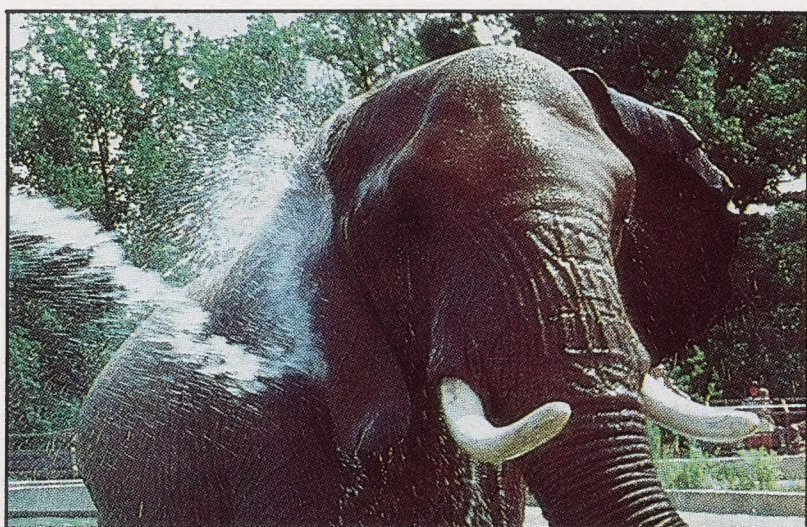
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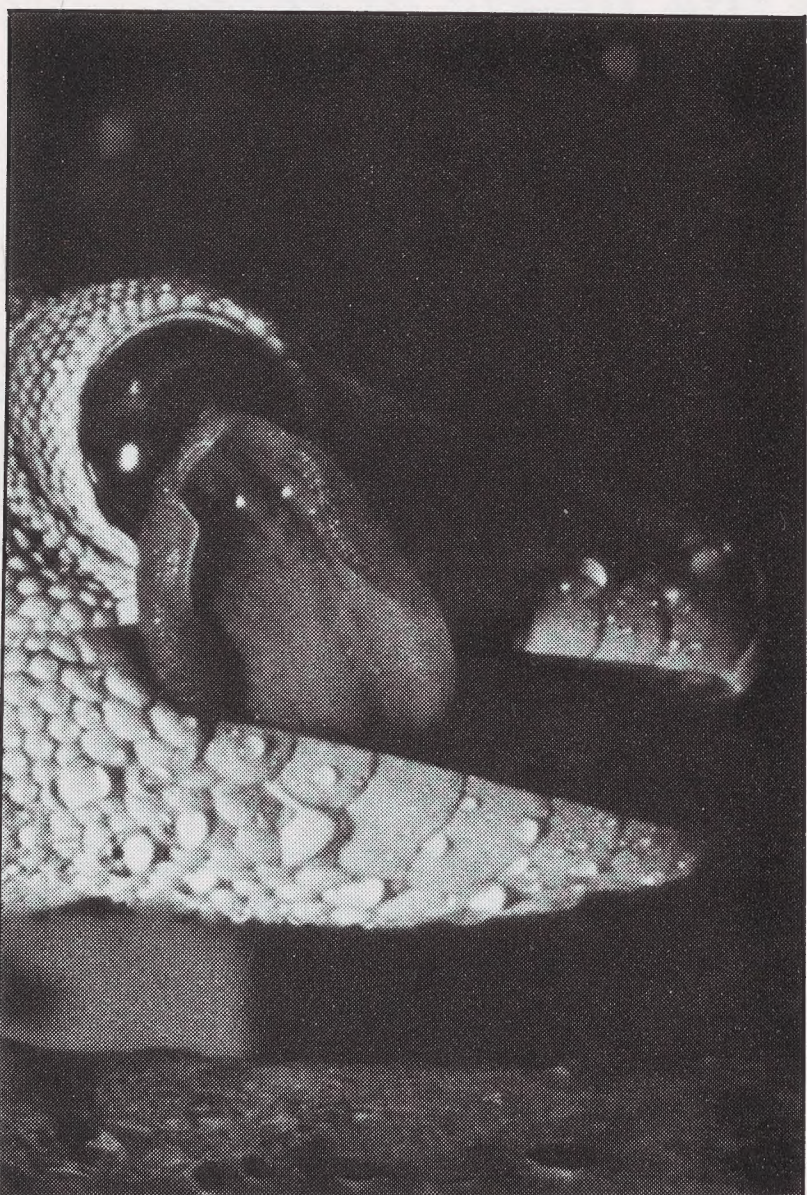
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The ruddy duck is one of 25 A.D.O.P.T. bird species. Call 673-4637.



African elephant (p. 4)



Giant day gecko (p. 9)



White-cheeked gibbon (p. 9)

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Cover: Detail from "Canada Geese," an acrylic painting by NZP artist Warren Cutler, celebrating ZooFari's Canadian wildlife theme (p. 10). **Back cover:** A ghost crab scuttles along the sandy beach. Unlike its close relatives, the shrimps and lobsters, the crab has no tail and is able to move quickly in all directions to escape predators. About a half-dozen species of crabs are on display in the Zoo's new Invertebrate Exhibit (p. 23). Photo by Benjamin Boblett.



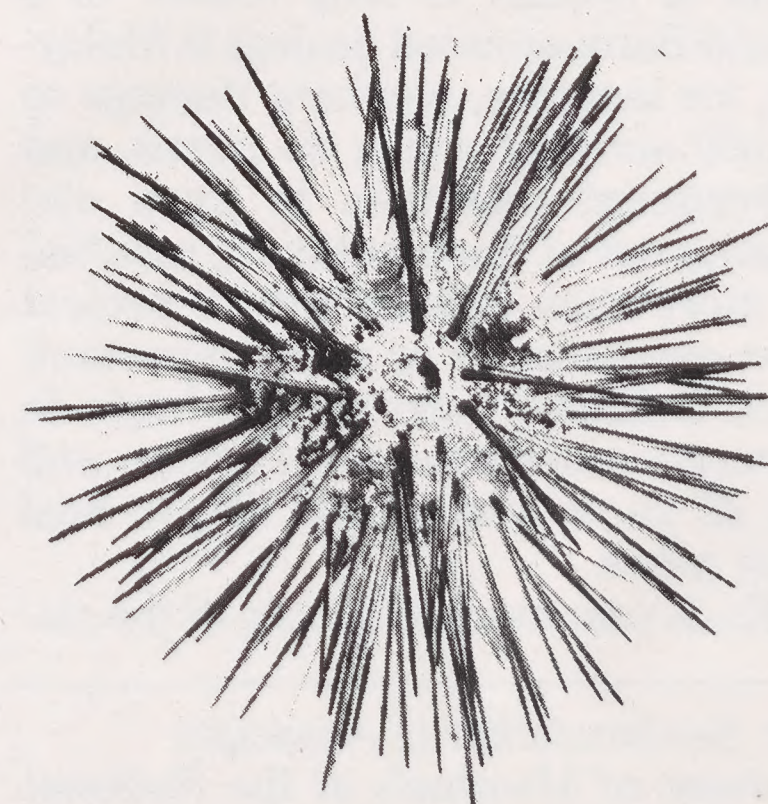
Barro Colorado Island (p. 15)



Black duck (p. 18)

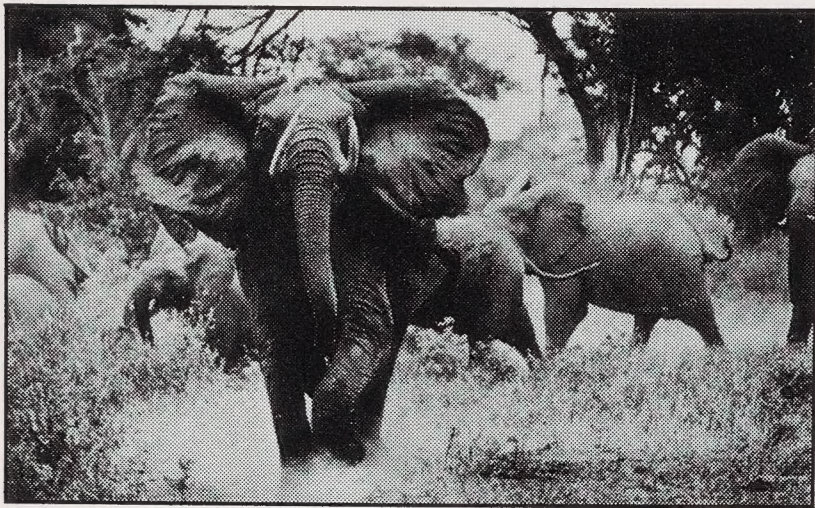


Blue-crowned motmot (p. 20)



Sea urchin (p. 23)

Elephants at War



During daily training sessions, FONZ volunteers explain to Zoo visitors how elephants behave and are cared for in captivity. But elephants in the wild have far too few “interpreters,” and development experts frequently overlook the needs of these magnificent, complex creatures.

Susan Lumpkin and John Seidensticker

Q: What do you do with a 10,000 pound elephant?

A: Whatever it wants you to do.

The over-ripe mulberries littering our yard demanded to be squished—and our two-year-old Lesley gleefully obliged. Stepping carefully, taking them one at a time, she squished berry after berry beneath her bare feet. Her delight in feeling the pop and ooze of sticky purple underfoot was reflected in the shine of her eyes. Watching Lesley brought elephants to mind. Yes, elephants: elephants who wander into an oil-palm plantation, and, stepping carefully, taking them one at a time, stomp sapling after sapling into the ground. And with no more apparent purpose than our daughter had except, perhaps, to experience a similar sensual pleasure.

But Lesley's game was harmless; the elephants' is not. It costs plantation owners, and the economic development agencies backing them, millions of dollars in crop losses. In a World Bank-assisted project in Malaysia, for instance, elephant damage to 82,500 acres of young oil palms, and subsequent measures to keep elephants out of the plantation, resulted in more than \$16 million in project cost overruns. As or more important, such incidents make people begin to perceive wild elephants as pests—and we all know how people like to deal with pests.

Each year more and more of the ele-

phants' habitat in Asia and Africa is lost to development. The animals' native forests and grasslands are converted to grow timber or crops, or disappear with the construction of hydroelectric plants and reservoirs. The problem is not unique to elephants: Throughout the world, the need for economic development to support human populations often conflicts with the need for habitat conservation to support wildlife populations.

What is unique in this case is that elephants don't quietly disappear along with their habitat, unlike, for example, a multitude of insect species that are becoming extinct before they can ever be “discovered.” Elephants are fighting back.

All too often, projects are sited in and around prime elephant habitat, and most elephant depredation is simply the result of elephants behaving as usual, despite or in response to the new feature in their environment. But because the cost of their battle can be measured in lost dollars, elephants may be able to persuade economic planners to consider equally the needs of wildlife and people when development projects are designed.

The Battlegrounds

Elephants, both African and Asian, prefer ecotone habitats: The “edges” between forest and grasslands or between moderate tree cover and savanna. Here both grasses, which compose the bulk of the elephants' diet, and trees, which offer browse and shade, are abundant. But even edges are suitable only if they also contain well-dispersed, permanent sources of water. Elephants, espe-

cially Asians, must drink and bathe regularly—once a day or more often if the water supply allows.

Imagine, then, what it means when a field of sugar cane, criss-crossed with irrigation canals, suddenly appears next to a forest. It means, ironically, that even as agriculture or forestry development usurps natural elephant habitat, it creates an artificial “habitat” very attractive to elephants. The elephants' response to the man-made edge is not surprising. They charge in to eat. Plantations of sugar cane, rice, teak, oil palm, and rubber—often situated in traditional foraging areas—provide rich patches of food for elephants, who know a good food source when they see it. Similarly, a dam or reservoir, by offering a permanent source of water, may turn a previously marginal area for elephants into an excellent one; the water will hold an elephant clan in the project area and unless something is done to stop them, members of the clan then forage in nearby agricultural fields.

The amount of food eaten by these marauding elephants is not minor. An adult Asian elephant consumes up to 330 pounds of vegetation each day, an African up to almost 500 pounds. Moreover, females, at least, rarely forage alone. Elephant cows live in small, tightly-knit groups composed of close relatives—mothers and daughters, aunts and cousins. An average-sized clan, with each member eating at a rate of 15 pounds an hour, can quickly wreak havoc.

“Nancy,” the National Zoo's African elephant, belongs to an increasingly threatened species.

Dr. Seidensticker is Associate Curator of Mammals at the National Zoo; Dr. Lumpkin is an NZP Research Associate.



Development will undoubtedly survive the elephant problem. Whether elephants will survive development is much less certain.

A few figures from Sri Lanka illustrate the extent of the problem. Two groups of elephants, one with six members and the other with 15, invaded a plantation and in one night consumed or destroyed about \$450 worth of bananas—and in Sri Lanka that's a lot more bananas than \$450 would buy in our local supermarket. The same elephants destroyed about ten acres of rice paddy and damaged another ten in just two nights; the nine farmers whose fields suffered in this raid lost at least 25 tons of rice; two of these farmers reported that elephants inflicted further damage within the next ten days. In another village, a farmer reported that the cost of "supporting" the local herd of 25 to 30 elephants with his crops amounted to a quarter of his farm income. On a larger scale, between 1977 and 1979, Sri Lanka's Kantalai Sugar Corporation lost more than \$100,000 in sugar revenues as a result of elephant activities and, in 1977 alone, elephant depredations on 4,500 acres of teak plantations cost an estimated \$75 million loss of future revenues.

Dangerous Skirmishes

Sometimes elephant clans become trapped or "pocketed" in isolated forest islands surrounded by human development. Cut off from adjacent forest tracts, the pocketed elephants become permanent residents in the project area. They hide in their patch of forest by day and make forays into plantations, now their only source of food, by night. Because they live so close, the elephants are dangerous to people, who are often surprised by the number of elephants they have for neighbors.

A pocketed herd creates problems for a development project; becoming pocketed creates problems for the herd. If the herd is large enough, it rapidly depletes the food resources of the forest island and the fields; the animals then face starvation. Or, because these elephants threaten lives and livelihoods, they are (illegal-

ly) shot. Even in Sri Lanka, where elephants are culturally revered as well as legally protected, farmers seeking to salvage their crops shoot about 50 elephants each year.

For the sake of the people, the project, and the elephants, pocketed herds must be moved—a costly, dangerous, and not always successful undertaking. In Sumatra, for example, 100 elephants were relocated away from a project area, at a cost of about \$150,000. But, perhaps displeased with their exile, the animals tried to return to their original habitat; along the way, they damaged an entire settlement.

Aside from the pocketed-herd phenomenon, development projects can interfere with migratory patterns within the elephants' home ranges. These ranges vary widely in size, but everywhere they are large: from 3.8 to 6.5 square miles for an adult male in the dry zone monsoon forest of Sri Lanka to more than 1000 square kilometers for a cow clan in the seasonal environment of Kenya's Tsavo National Park. Home range size is largely determined by the availability of resources—an elephant clan must have year-round access to predictable sources of food, water, and minerals. Home ranges of adult males, who travel alone or occasionally with one or two other males, are further influenced by the availability of females with which to breed, and so must include at least part of the ranges of several clans of cows.

Migratory routes—to water holes, mineral licks, and seasonal foraging areas—are learned as elephant calves mature within a cow herd. When a development project, dam, or canal, is sited on one of these traditional routes, the elephants may be unable to find the single reliable source of food, water, or minerals available at that time of year. Potentially disastrous for the elephants, such a situation may, in addition, prove disastrous for the project. Elephants are strong, and strong-willed, and may barge

right through a project area, creating a crossing where none was intended or desired.

The usual "solution" to elephant depredations is to erect barriers to keep the elephants out of the project area. But elephants respond to these barriers — steep-sided ditches or fences, often electrified—by trying to go through them. And when an elephant is determined, it usually succeeds. Using feet and head, elephants will fill ditches with earth. Erosion of ditch systems, a fact of life in the wet tropics or during wet seasons, is accelerated by the elephants' activities, quickly rendering the systems worthless. Elephants may push a tree over a fence, or simply topple the fence. Even electrified fences can be dealt with, since ivory tusks do not conduct electricity. Alternatively, the elephants may just walk around the barrier.

Of course, technology can triumph over elephants. High power energizers and elaborate fences seem to work in some cases in Asia and Africa. But effective barriers like these are extremely expensive to build and, because they require constant and costly maintenance, often do not remain effective for long.

Development will undoubtedly survive the elephant problem. Whether elephants will survive development is much less certain. There is already grave concern among conservationists about the status of elephants. Between 23,000 and 41,000 elephants still live in Asia; between 1.4 and 1.6 million still live in Africa. This may sound like a lot of elephants, compared, say, to the few hundred remaining giant pandas in China or to the dozen or so surviving Guam rails. And it would be a lot of elephants if they all lived in the same place. But in both Africa and Asia, the elephants live in disjunct, widely scattered, and relatively small populations, composed of as few as 60 individuals, which are separated by vast stretches of impassable terrain. Each population is essentially "pocketed," al-

Where elephants live, so do people, and in these generally impoverished countries, economic realities demand development.

though the size of its habitat island may be large.

Small, isolated populations are prone to both sudden and slow extinction. A drought, hurricane, volcanic eruption, epidemic, or simply a determined group of poachers may wipe out an entire population virtually overnight. A change in climate that reduces the food supply of the "island," either temporarily or permanently, may lead more slowly to mass starvation. And finally, over an even longer period of time in the case of elephants, extinction may ultimately result from the deleterious effects of inbreeding, for when immigration and emigration are impossible, no new genetic material can enter the population. For these reasons, the Asian elephant is listed as "endangered," the African as "threatened," and both species are legally protected everywhere they occur.

Preventing Battles

Although some people might wish it, good economic development projects should not and probably cannot be stopped. The future well-being of millions of people depends on them.

What then can be done to reconcile elephants and development, to mitigate their mutually destructive relationship?

The first step, the one that elephants by refusing to be bullied have already forced, is simply the recognition by development agencies that elephants must be considered during the early stages of project planning and design; that preventing a battle is cheaper than winning it. In some cases, this means that conflicts between development and elephants can be avoided by knowing where elephants live and putting projects somewhere else. But where elephants live, so do people, and in these generally impoverished countries, economic realities demand development.

When a project must be located in elephant country, advance planning to accommodate or to contain elephants

can greatly reduce future conflicts. If a canal lies along a traditional elephant migratory route, incorporating crossings into the design of the canal will guard against the damage done when elephants try to make their own crossings, while ensuring that the animals can reach the food or water they need to survive. A buffer zone between forest and plantation, from which food and cover have been stripped, is an effective barrier to potential crop marauders. A wall will challenge elephants to get through to the tempting fields beyond; but a barren swath forms a natural barrier that forest elephants have no incentive to cross. A buffer zone need not be useless: A broad grassland over-grazed by domestic livestock may be an excellent barrier to elephants.

Finally, elephants can be both accommodated and contained by creating or enhancing elephant habitat away from project sites. Since elephants range only as far as they must to find year-round food, water, and minerals, planting a favorite food, digging a water hole, or creating a mineral lick can reduce the elephants' range, holding them in areas away from a project. Sometimes even habitat within the project—the banks of reservoirs or watershed protection areas—can be enriched so it supports elephants and thus keeps them out of agricultural production areas.

Planning for Peace

Many development projects rip through the ecological fabric of an entire region, altering the environment beyond the boundaries of the project area, with far-reaching effects on all wildlife. What is needed is not just a few measures to control elephant depredations, but plans and policies that include natural resource conservation as an integral part of economic development. Elephants can spur and focus efforts to devise such plans and in at least one case have done so:

Sri Lanka's highest development

priority is currently the Accelerated Mahaweli Program, one of the largest river basin development schemes ever to be undertaken in Asia. Under this scheme, 292,500 acres of dry-zone land will be irrigated so about half a million people can be resettled on small farms; as a result, annual food production is expected to increase by 547,000 tons. To do this, four dams, which will also double Sri Lanka's capacity to generate electricity, are being built on the Mahaweli River. The Program encompasses over a million acres of land, 20 percent of it hitherto undeveloped expanses of prime wildlife habitat — home to myriad species, including Asian elephants, leopards, purple-faced langurs, and six other threatened or endangered species.

In 1979, the U.S. Agency for International Development (AID) funded the first environmental impact assessment of the Accelerated Program. It was clear that the effects on water and soil quality, on wild land and life, on forest and stream would be severe. Moreover, the 800 or so elephants living in the area were already devastating resettled farmers' crops and communities.

The government of Sri Lanka was concerned about both environmental degradation and elephant depredation, and with the help of AID developed an environmental action plan, out of which the Mahaweli Environment Project was born in 1981. Financed largely by a \$5 million grant from AID, this project is considered a model of how conservation and development can be integrated. The project has two key elements:

First, four national parks or reserves will be created or expanded in the Mahaweli region, for a total of about 470,000 acres of protected land for wildlife. Boundaries will be established to prevent people encroaching on the parks, and roads built to service the parks. Buffer zones will keep people and plantations separate from parks and elephants. Habitat enrich-



Long revered as sacred and valued as a domestic animal, the Asian elephant is now perceived by many as a pest.



Wild Asian elephants often become pocketed in perilously small populations.



The Zoo's elephants, like their wild counterparts, require a lot of water.

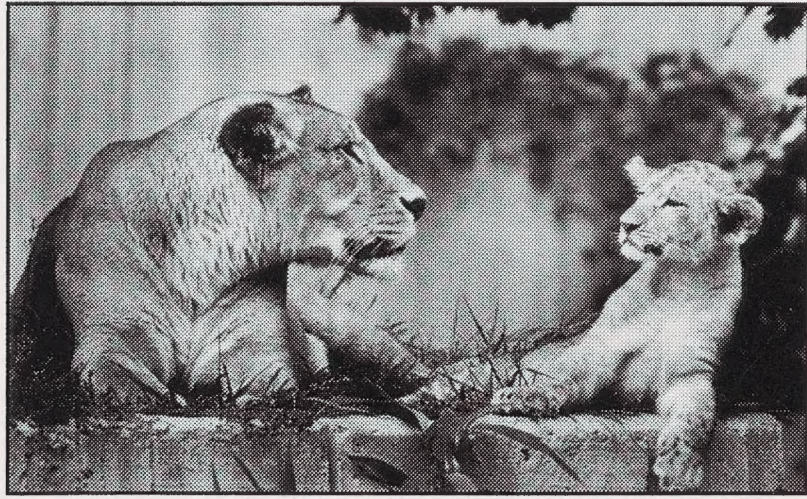
ment programs will be undertaken to support the parks' wildlife populations.

Second, the ability of Sri Lanka's Department of Wildlife Conservation to manage these national parks will be strengthened. This is to be accomplished by hiring more than 200 people to plan, manage, guard, and maintain the new parks, and by providing training and technical assistance to the Department's current and new wildlife employees. Wildlife research will be supported, and a public-awareness program will help educate local people on the value of the protected area system.

While protecting some of the region's wildlife, this project will at the same time benefit the people in the Mahaweli. Buffer zones will reduce crop losses to elephants and other wildlife. Construction and management of the parks will create numerous jobs for local residents, and income and employment from tourism will follow. The maintenance of natural areas will help to reduce flooding and protect watersheds and downstream fisheries, which are of major economic importance in the Mahaweli region. The improvement of Sri Lanka's capacity to manage the new protected areas will, by extension, improve its ability to manage the wildlife resources of the rest of the country as well. And finally, some of Sri Lanka's precious natural heritage will be preserved for its people. All this for a paltry investment of about \$5 million of the more than \$2 billion being invested by foreign donors in the Accelerated Mahaweli Development Program.

Of course, even an exemplary project like this is at best a compromise solution, with wildlife doing most of the giving and development most of the taking. What's more, implementation of this and similarly ambitious conservation plans often lags behind other aspects of development projects, provoking fears that it may come too late to make much difference—and, at press time, civil strife in Sri Lanka has interrupted the project's final stages. Nonetheless, even a slowly implemented, best-of-a-bad-deal resolution of the conflict between elephants (and all wildlife) and development is better than none at all. Without such a compromise, ultimately and unfortunately, elephants will probably lose their war against people. □

1986 FONZ Annual Report



As the Zoo's 100th anniversary approaches, FONZ continues to flourish in its role as the institution's supportive Friends. "The state of our organization has never been sounder," said FONZ President Roscoe Moore in his 1986 report to members, highlighted below:

Record-breaking gross revenues generated by the ongoing success of FONZ food service, gift shops, parking lots, membership, A.D.O.P.T., and other programs totaled over \$7 million in 1986, including the value of some 35,000 hours of work contributed by 433 FONZ volunteers. The following is a brief outline of the scope of FONZ activities in 1986:

- In the area of conservation and research, FONZ supported 58 visiting scholars, project aides, and summer interns who worked with Zoo professionals in Washington and at the Zoo's Virginia Conservation and Research Center. Selected from a highly competitive field of applicants, the 1986 interns represented 19 universities in 14 states, as well as Canada and Iceland. Throughout the departments of the National Zoo, these young apprentices developed their already specialized knowledge through hands-on experience. Whether they've spent long hours in a scientific study, helped to conceive, write, and construct an educational exhibit, or assisted a veterinarian in the day-to-day care of the animal collection, the excellence of these FONZ-funded interns and assistants has been uniformly praised by an appreciative Zoo staff.

- In FONZ's founding charter, the one word chosen to crystallize our mission was "education." To this day, education remains the primary focus—and driving force—of FONZ. In 1986, FONZ worked in close cooperation with the Zoo's Office of Education to develop an ever-widening array of educational activities. But the most brilliantly conceived programs and learning materials would have little impact, were it not for the extraor-

dinary network of FONZ guides and volunteers who bring these lessons to life for thousands upon thousands of Zoo visitors each year. In 1986, some 45 FONZ tour guides introduced more than 10,000 school children to the wonders of Zoo wildlife. While these structured tours constitute the solid core of the FONZ education program, our efforts to reach out to the broadest possible spectrum of zoo visitors go far beyond. For example, a dedicated and growing team of guides works overtime to offer tours and lessons that are sign-interpreted for the hearing impaired and custom tailored to other specially challenged groups. Thirty-six roving guides roam the Zoo on weekends to answer the public's myriad questions, while 39 volunteers now regularly staff the popular family learning labs—ZooLab, HerpLab, and BirdLab. And 64 FONZ Junior Zoo Aides spent the summer of 1986 staging daily puppet shows which delighted some 21,000 youngsters and adults, while teaching respect for endangered animals in the Zoo and in the wild.

- In 1986, 106 trained animal behavior watchers—all FONZ volunteers—assisted Zoo researchers in fascinating studies of little-known species. Other volunteers worked at even closer range, helping to hand-rear animal infants orphaned or rejected by their mothers, or laboring from dawn to dusk and beyond as volunteer bird and mammal keepers at the Conservation and Research Center.

- In addition, an exciting horticulture program was launched last summer, with 17 volunteers assisting the Zoo's gardening staff. Since the program's inception, these volunteers

have contributed over 700 hours to beautify the Zoo's landscape.

- Also last summer, FONZ assumed the administrative responsibilities for the keeper aide program. Since that time, 33 volunteers have been placed to assist keepers in such areas as the Invertebrate Exhibit, Elephant House, and Reptile House.

- Another major contribution to the Zoo has come from FONZ's annual fundraising gala, ZooFari, which last May raised almost \$50,000 for the Theodore H. Reed Animal Acquisition Fund. Honoring retired Zoo Director Reed, the annual benefit is inspired by the wildlife of selected theme countries; 1987's ZooFari, for instance, will feature a distinctly Canadian flair. 1986 ZooFari proceeds were used in part to acquire two otters, four giant squirrels, and a tapir.

- In our Publications Department, 1986 saw the publication of a special ZooGoer issue on the National Zoo's Research Department, the updating of the Zoo guidebook, a better-than-ever color calendar for members, broader coverage of conservation issues, and the introduction of several popular new ZooGoer features. Our children's publication, *PawPrints*, now includes more educational games, at the request of readers, and has expanded its school distribution at the request of teachers.

- Our Food Service Department grossed \$2.6 million in 1986, with August the Department's most successful month ever.

- FONZ's Merchandising Department also had a record-breaking year in 1986, with revenues reaching almost \$2.4 million. In May, the top month for Merchandise sales in 1986,

Join the Fourth Annual ZooFari: A Salute to Canada

May 29, 1987 7-10:30 p.m.

FONZ's primary fundraising event for rare species acquisition, transportation, and breeding is ZooFari—a gala evening of fine dining and dancing, silent and live auctions, strolling bagpipers, and animal exhibits, with musical entertainment by the Royal Canadian Regimental Band.

Tax-deductible tickets to ZooFari are \$125 and will benefit the Theodore H. Reed Animal Acquisition Fund. Call 332-WILD for your invitation to ZooFari.



Limited Edition ZooFari '87 Artwork Celebrating Canada

"Canada Geese," by noted wildlife artist Warren Cutler, is available in a special ZooFari limited edition, signed and numbered, 25½" × 32", \$135 including tax and handling.

Warren Cutler is an internationally recognized scientific illustrator of rare and endangered species, and has been working with zoologists and ornithologists for over 13 years. The Jersey Wildlife Preservation Trust in Great Britain and the Brazilian government have used his work to publicize their efforts for the preservation of endangered wildlife. In addition, his work is a part of the Smithsonian Institution's permanent collection in Washington, D.C.

To order "Canada Geese," fill out the coupon below or phone credit card orders to 332-WILD.

To: FONZ ZooFari '87, c/o National Zoo, Washington, D.C. 20008

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60,875 people visited FONZ shops and spent a total of \$410,500.

- In our Parking Department, the purchase of state-of-the-art parking equipment during 1986 was a tremendous improvement. We can now instantly verify the number of parking sales, and we are equipped for variable pricing, based on length of stay or time of arrival or departure, should we need to implement such a plan to control peak parking.

- We hope that you have noticed greater enthusiasm and courtesy among FONZ's parking attendants as well as other FONZ employees over the past year. Some of the credit goes to a four-hour training program initiated by the Human Resources Department. The program covers the history and purposes of FONZ and the National Zoo, a tour of the Park, communications skills, and safety. This training helps employees in Food Service, Merchandising, and Parking to give the best.

- Zoo visitors also benefited in 1986 from FONZ support for such popular special events as the winter Sunday Afternoons at the National Zoo family activity programs and the sixth annual National Zoo Symposium for the Public, which dealt with highlights of almost two decades of animal studies at the Zoo, and for the first time ever, featured a FONZ volunteer—veteran behavior watcher Nell Ball—as a speaker.

- Other new and exciting programs at Friends of the National Zoo included the Membership Department's classes on topics such as "Animal Intelligence," "Advances in Reproductive Biology," "Zoo Herpetology," "Junior Shutterbugs," and "Small Mammals in a Big World." The children's "Summer Safari" weekday class program was especially popular.

- In 1986, FONZ's Membership Department instituted two new fundraising programs to benefit the National Zoo's animal and research projects: A.D.O.P.T. (Animals Depend on People Too) and special membership categories (Benefactor, Sponsor, and Patron). Listed below are the species featured in the A.D.O.P.T. program and the "honor roll" of the program's charter members. Thank you for your support!

A.D.O.P.T. Sponsors — Bald Eagle:
Mike Act, Lydia Adelfio, Brian Archer, W. H. Baar, William Cornelius, Karen Davis, Caryl Dawson, Keith Field, Fred Gantzler, Daniel

Gordon, Mr. & Mrs. F. H. Habicht, Mrs. M. Henderson, M. Jamison, Judy Kelly, James McLeod, Andrew Perlberg, Billy Sahm, Louise Watkins. **California Sea Lion:** Earl & Francis Collier, Mary-Blair Valentine. **Fennec Fox:** Sandra Allison, Elmer & Deith Barth, Walter Bender, Clemens & Marj Bribitz, Mr. & Mrs. Bernard Davis, Mr. & Mrs. George Fowler, Lee Geismar, Kathryn Getek, Mathew Gibson, Stephen & Jean Hersh, Joyce Kersey, Frederick Miller, Howard Richings, Joy Rubinstein, Mrs. Hernan Torres. **Geoffroy's Cat:** W. L. Billett, Kathryn Bruner, Thomas Cardarella, Mr. & Mrs. Anthony Collins, Dean Craig, Myris & Jim Dierlich, Ardythe Ellison, Mr. & Mrs. Albert Elrod Jr., Karen Gibson, Robert Hall, Robert Howard, Ellen Jones, Mr. & Mrs. Brian Kirkpatrick, Mrs. E. Kramer, Mr. & Mrs. Melvin Mason, James Miller Jr., Mr. & Mrs. Larry Millspaugh, Donna Minner, C. W. & Barbara Morris, John Norris, Mrs. Warren Smith, Mrs. F. Stanley, Gary Terrill, Ruth Tyler, Susan Whitmore, Susan Wilson, Julie Wormhoudt. **Hammer-Headed Bat:** Ray & Sue Cole, Lyn Mortimer, Mr. & Mrs. Marvin Schneck. **Leech:** William Marsland, Thomas & Ine Noe. **Malayan Tapir:** Perry Fitzhugh, N. E. Wiswall. **Nile Hippopotamus:** George Meredith Family, Mr. & Mrs. Robert Mueller, Hershal Thompson. **Octopus:** Andrew Perlberg, Barbara & Scott Levine, Irving Paskowitz, William Queen, Adam Tuck. **Pere David's Deer:** Mrs. Maurice Maser. **Red Kangaroo:** Hazel Hestand, Lisa Boepple, A. G. Burbank, Wendy Jones, Mr. & Mrs. David Kenney, John & Susan Muehl, Mark Ricard, Jane Stunkel, Mr. & Mrs. Thomas Wiseman. **Tawny Frogmouth:** Mary Knoblauch, Winifred Weislogel. **Aldabra Tortoise:** Mr. & Mrs. Thomas Bailey Jr. **Harvest Mouse:** Mr. & Mrs. Edward Boniface. **American Flamingo:** Jim Morgan, Ardith Nahan, John Oakes. **Barbary Ape:** Jaskar Family, Diana Muss. **Dorcas Gazelle:** Barbara Eisinger, Lauriston Hardin. **Elephant:** Jerry & Vicki Bonham, D.R. Cordiano, Mrs. Norment Custis, Barbara Gouldthorpe, Mrs. M. Henderson, Mr. & Mrs. Maxwell Helfgott, Amy Kirshner, Dr. & Mrs. A. Koezen, S. V. Krusiewski, Melvin Lerman, John O'Loughlin, Diane Peterson, Nelson Pierce Jr., Karen Saffitz, Gerry & Chris Treanor, Gary Ward. **Fisher:** Sandra Merrigan. **Gharial:** R. Battisfore-Kokob. **Hermit Crab:** Mr. & Mrs. Robert Avery, Bonita Bender, Mr. & Mrs. M. S. Bradley, Mr. & Mrs. Jonathan Brillhart, Steve Krenzer, Jeff Patterson, Jessica Racusin. **Lion:** W. L. Billett, C. O. Kirkland, Alexander Orlofsky. **Mandarin Duck:** Beauvoir Elem. School, Doris Bitler, Linda & Clayton Blick, Mari Ann Boyd, Daniel Chan, Stephanie Duke, The Four M's, Marie Haywood, Cristin Howley, Mary Jensen, Mr. & Mrs. R. C. Johnston, Mr. & Mrs. Brian Kirkpatrick, Mrs. E. A. Marks Jr., Neil Martin, Christine McNerney, Ruth Staver, Ewa Swenson, Jonathan Tullis, Jim Updike. **North American Bison:** Mr. & Mrs. Sylvan Feigenson, Patricia Hubbard. **Orangutan:** H. L. Berry, Marilyn Bloomberg, Mr. & Mrs. Gerhard Brown, Mr. & Mrs. Paul Carroll, Amelia Darr, Karen Davis, Martha Davis, Cindy Frank, Louise Harper, Dan Heinemeier, Mrs. Donald Ker, Barbara MacFate, Robert & Lynda McCall, Jacqueline Pierce, George Savitske, Joseph Stengel, Peggy Twohig, Cheryl Wagner, Lori & Doug Wenger. **Pink-Backed Pelican:** John Oakes, Judith Veihmeyer. **Red Panda:** Margaret Babbitt, Carolyn Frank, Heather Gago, Fred & Pat

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A.D.O.P.T. species photos by Jessie Cohen, NZP Graphics: Asian lion (p. 9), bald eagle (p. 11), white-cheeked gibbon (pp. 12-13), and giant day gecko (p. 14).

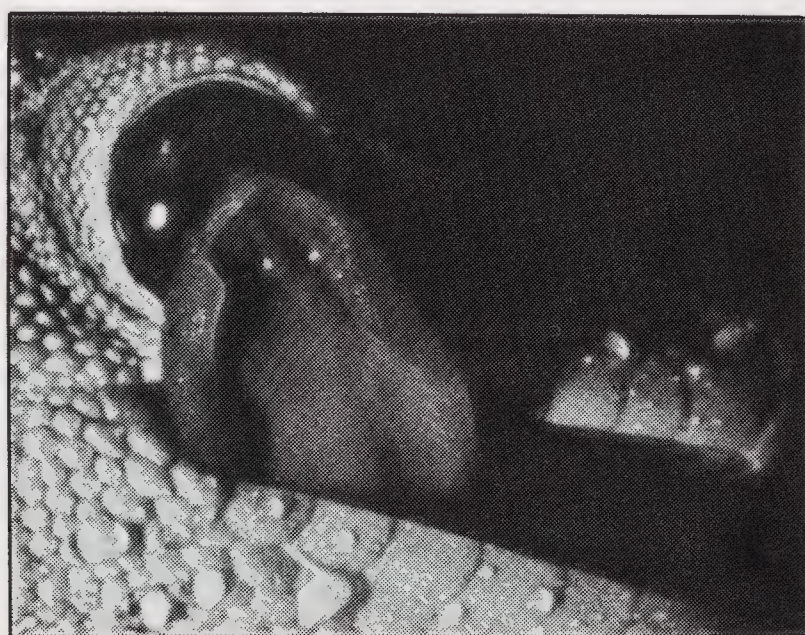






Frank & Agnes Peters, Margaret Rathell, Tim & Ellen Sleeth, Deborah Smith, Mr. & Mrs. Donald Smith, Eleanor Wyatt. **Ostrich:** Anne Lee Bartlett. **Prevost's Squirrel:** Edward Levine, Lucinda Meehan, Iris Rothman, Howard Whittington, Mr. & Mrs. Gary Wright, Pleasant Valley School. **Red-Kneed Tarantula:** Ms. J. M. Alling, Laura Atwood, Adam Baacke, Daniel Babiec, Andrew Black, Anne Bouchette, Ruth Brocks, Matthew Brown, Pam & Bill Camp, Mr. & Mrs. Leon Chaffee, Jim Harvey, William Handrix Jr., Patricia Hubbard, Ellen McBride, Mr. & Mrs. George Perkins, Karen & Margie Ritter, Heli Trees, Lynn Wait, Jane McGovern, Phoebe Rhodes. **Serval Cat:** Elaine Eiserer, Juliet Lohr, Mr. & Mrs. Thomas Miller. **Timber Wolf:** Mr. & Mrs. Gene Aulenbach, Roberta Barnes, Elaine Barr, Mr. & Mrs. Allen Berndt, W. L. Billett, W. Bishop, Ann Bixby, Lorna Bridenstine, Mary Callahan, Mr. & Mrs. Leon Chaffey, Mr. & Mrs. Jerry Dalpias, Katherine Dante, Gayle Downing, Lorrie Earle, Joann Elferink, Warren Erickson, James Fleming, Denise Folley, Mr. & Mrs. Mark Fried, John Goetke, Tommy Gough, Joy Gournic, Col. & Mrs. Frank Gregg, Susan Gustafson, Ruth & William Hahn, Hazel Hestand, Patricia Haller, Ginger Hamilton, K. Harwood, Mr. & Mrs. Barry Hemphill, Mrs. M. Henderson, Sandra Holton, Jean Keeting, Ann Kline, T. R. Kupferman, Jane Linkletter, Karen & Calvin McMann, Mrs. Glen E. Nielsen, Lynn Offermann, Mr. & Mrs. Edward Owen Jr., Ruth Parker, Diane Peterson, Marcia Pickering, Gary & Sheila Powers, Mary Quillin, Catherine Ribnick, Marion Rogers, Lois Smith, Dorothy Stewart, Mr. & Mrs. Robert Tallaksen, Muriel Thorne, Brenda Toms, Barbara Wade, Jean Willis, John Winkles, Sandra Wiskow, Margaret Wylie. **Binturong:** Mr. & Mrs. Francis Woods. **Puma:** Alice Shaver. **Anemones:** Caryl Dawson, John & Maura Barber, Ms. E. N. Wengenroth, Mr. & Mrs. Leo Williams. **Black-Palm Cockatoo:** Truman Maynard, Charles Busch, Mary Parker. **Giant Day Gecko:** Dorothy K. Clark, Maura Howley, Jack Weisman, Ann & Brooks Wramplemeier. **Masai Giraffe:** H. L. Berry, Joanne Buehler, Mr. & Mrs. Michael Callahan, Frances Chiles, Sascha Fisherman, Mary Ann Garth, Sharon Genzen, Elizabeth Kelne, Mr. & Mrs. Nate Kelne, Susan Longstreet, Mary Lucas, Pamela Mahn, Joann Musson, Stephanie Slachman. **Pygmy Hippopotamus:** Bonnie Lepard, Karen Shinevar, John Cross III, Joanne & Larry Hitchcock, Jean Liebenberg, Bruce Reed. **Slender-Tailed Meerkat:** Rick Adams, Mr. & Mrs. Robert Avery, Duane & Judith Bowman, Mr. & Mrs. Henry Bullamore, Dr. & Mrs. Art Butterfield, Michael Chow, Jo Crum, Mr. & Mrs. Edwin Danaher, Lee Hanley, Charles Harwood, Robert Hodges, Olive Holbrook, Douglas Hoylman, Betty Jacobs, Mr. & Mrs. James Kelly, Marjorie McClain, Howard Richings, Anita Risser, Paula Rubinoff, Mildred Smith, Diane Terry. **Toco Toucan:** Geert De Prest, Eleanor Cross. **Hairy Armadillo:** Mr. & Mrs. Robert Avery, Jonathan Axelrod, John & Andrea Barnold, James Collins, Anthony Digiovanni, Victor Echevarria, Pete Hakel, Pamela Jamarik, Gwen Keifer, John Lebedda, Chuck & Lauren Lewis, Ashley Marton, Becky McKee, Elizabeth Pollard, Mr. & Mrs. Lawrence Proctor, Reilly Family, Carolyn Rhyne, W. Sause, Diane Taylor, Cindy Todd, Mr. & Mrs. Arthur Tritch, Penelope Waite, Cheri West. **Black-Tailed Prairie Dog:** Mr. & Mrs. Robert Hall, William Turrentine, Mr.

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Richard Mahla, Mr. & Mrs. E. J. Malek, Elizabeth Marchalonis, J. J. Marr, Kelly & Kristen Martin, Brian McCracken, Dan McDavid, Cheryl McKy, Mr. & Mrs. Daniel McMullen, Debra Miller, Barbara Miller, John Mitchell, Antonia Morgan, Violette Muller, Alex Y. Mutch, Victoria Nerva, Joan Owen, Franz Peterson, Courtney Powers, Mr. & Mrs. Alfred Ranno, Dorritt Redding, Janet Rice, Courtney Rodgers, Angela Roth, Mr. & Mrs. Rouse, Mary Beth Rucker, Mr. & Mrs. Gunther Sadel, Peter Sarpolis, John Sawyer, Judy Schmidt, Rachel Schneebaum, Nancy Schweickart, Linda Snyder, Mrs. Harold Spencer, A. D. Spevack, Barrie Staren, Mrs. C. J. Stattler, Maj. & Mrs. James Stieber, Sweeney, Sandra Taylor, Mrs. Charles Thomas, Brandy Threadgould, Mr. & Mrs. Ira Tice Jr., Barbara Turnbull, Florence Wainner, Robert Neal Winters, Mrs. R. Zakutansky. **Colobus Monkey:** National Starch & Chemical Corp. **Giant Panda:** Rino & Laura Aldrighetti, Lois Bitler, Mary Casey, Cloverhill High School, Carol Cudak, Anne Dewey, Daniel Gordon, Alison Grinthal, Mrs. M. Henderson, Hazel Hopf, W. M. Johnston, Jeremy Kanter, Deborah Kennedy, Nancy Lewis, Neil Martin, James Myers Family, Krissie Norisette, Laura Parjani, Katherine Rucker, Kathryn Schultz, Ann Thompson, Mr. & Mrs. Robert Valenziano, Melissa Warren, Pauline Watson, Renee Weihe, Kenyon Whitehead. **Mata Mata Turtle:** Mr. & Mrs. Bernard Davis, Nicholas Hassay, Mrs. M. H. Simons Jr. **Small-Clawed Otter:** Mrs. William Dockendorf, R. A. McGehee, Timothy

Thompson, Chris Woodall. **Trumpeter Swan:** Betty Hembrough, John Oakes, Martha Dalton, William Davis, Mr. & Mrs. C. H. Kibbee. **Arrow Poison Frog:** Dr. J. E. Blanchette, Joyce Kraimer, Donald McAllister, Mr. & Mrs. Carl Miller, Mr. & Mrs. George Nelson, Kenneth Norris, Zachary Putnam, Jessica Smith, Nancy & John Wilson. **Bongo:** Nancy Lewis, Jan Davidson. **Emerald Tree Boa:** Anthony Boys, Don Naylor, Diana Norris, Mrs. Applewhite Watson. **Micronesian Kingfisher:** Fred & Pat Graboske, Teresa Ellis. **Snowy Owl:** Dan Boyer, Dr. & Mrs. William Combs, Emily Jones, M. E. McFadden, Mr. & Mrs. Stephen McKee, Harriet Wilt. **Burmese Python:** Mrs. Kerl, Paul & Joel Arberman, Ida Colford, Cat Greenfield, Elaine Mejstrik, David Moffitt, Roger & Leandra Peak, Mr. & Mrs. Carl Peoples, Rolfe Sauls, Mark & Liz Springer, Mrs. A. H. Sulzberger. **Cuban Crocodile:** Diana Baker-Clark. **Goeldi's Monkey:** Mr. & Mrs. Albert Dewey, Jr., Kerry Dwyer, Patrick Green, Mildred Helm, Jdh. & Suzanne Kane, Mr. & Mrs. Larry Marton, Richard Podrasky, Andrew Silverman, Mr. & Mrs. Gerald Snyder, Larry & Judy Winkler. **Spectacled Bear:** M. L. Aizenman, Joan Bartos, Jessica Plumptre, Debra Rich, Dr. & Mrs. Peter Roots, Jimmy Sensenbrenner, Dawn Simounet, Mrs. David Sparks, Kathey Underwood. **Burrowing Owl:** Lois Smith, Julie Colvin Clark, Larry Matheson, L. C. Northrop. **Cuttlefish:** Diane Wilshire. **Golden Lion Tamarin:** Cheryl Wagner, Dana Wollney, Shirley Bartash, Mary Chamberlain, Margaret Cureton, Anne Deluca, Kjayne Duerr, Esther Harlow, Sandra Harris, Frank & Billie Izenour, William & Kare Knecht, Mary Koles, Mr. & Mrs. Werner Kronstein, Chad MacWhinney, Kenneth MacWhinney, Mrs. T. H. McCoy, Dorothy Musler, Allan Neff, Catherine Reynolds. **Spiny Mouse:** Geert, DePrest, Christopher Thompson, Richard McCrellen Jr., Libby Waite, Dawne Spoon, George Astrove, Martha Baganz, Molly Buck, Betsy Buck, Jessalynne Charles, Suzanne Coyle, Donn & Arlene Dickson, Nancy Gibson, Thomas Hanna, Mr. & Mrs. Fred Hawthorne, James & Jill Henderson, Tom Heslin, Consuelo Hoff, Rita Hopf, Michael Kraskin, Eric Krasting, Dorothy Lucas, Emily Marton, Megan Marton, Astrid McHugh, Ruth Meehan, Carl Moskey, Kirsten Neergaard, Edith O'Connor, Mr. & Mrs. Mark Pankin, Steven Payne, Lina Reed, Angus & Emiko Reynolds, Barbara Ross, Kevin Wilshire, E. Wilson, Raymond Zimmerman Jr. **Dark Mongoose:** Robert Johnson, K. T. Kelly. **Golden-Breasted Starling:** Leah Baacke, Isabel Blair, Mr. & Mrs. Samuel Cottrell IV, Angela Flynn, Nina Fragola, Daniel Haber, Ameilia Ware. **Sponge:** Dawn Spoon, Christopher Thompson, Carol & Joe Palca, Shelley Graham Shepard, Patricia Nece, Walter Spiegel, J. Warren. **Gorilla:** Elizabeth Cooper, Eleanor Emch, Mr. & Mrs. Herman Fritz, Gary Holahan, Raelen Hourany, Mary Krahulec, Ken Lawwill, Richard McCrellan, Kathy Milholland, Mary O'Donnell, Carol & Joe Palca, Margaret Snyder, Harriet Straus. **Green Tree Python:** Christopher Kuciak, Rachel Miller, Joan Moore, Charles Pearson, Polly Penhale, Sharon & Jim Porter. **A.D.O.P.T. Contributions:** Deborah Smith, Mr. & Mrs. R. Arbeiter, G. J. Bravy, Gloria Davis, Mr. & Mrs. Raymond Edwards, Mrs. F. W. Herman, Mr. & Mrs. James Lacock, Theresa Lott, Catherine Magistretti, Kirk & Karen Moberley, Lois & Howard Rohr. □

In Search of Tropical Treasures

Over the years, FONZ research support has helped Zoo scientists learn more about the lifestyles of exotic species by studying the ecosystems in which they evolved. Field studies at the Smithsonian Tropical Research Institute not only have made it possible for NZP to house tropical animals like sloths and bats, but have added to scientists' knowledge of another critically endangered "species"—the tropical forest habitat itself.

Susan Weinberg

Rising in the middle of the Panama Canal is a biologist's paradise—an island of undisturbed tropical rainforest used exclusively by scientists to study the complex ecology of this most endangered ecosystem. Administered by the Smithsonian Tropical Research Institute (STRI) for the United States and the Republic of Panama, Barro Colorado Island has been called the most studied piece of tropical real estate in the world.

The rapid pace of tropical forest destruction makes the island a precious resource for biologists. Over the years, a number of Zoo researchers have conducted detailed studies of the island's natural history, hoping to gain a better understanding of the rainforest system.

The founder of NZP's renowned research department, John Eisen-

berg, used this wild "laboratory" for more than a decade, from 1964 through 1975, to study the ecology of tropical mammals: spider monkeys, agoutis, Geoffroy's tamarins (relatives of the now-familiar golden lion tamarin), two- and three-toed sloths, and lesser and silky anteaters. A number of NZP-affiliated graduate students assisted Eisenberg in this work, dividing their time between field and captive studies. Several of these students, including Nicholas Smythe, Nancy Muckenhirn, and Wolfgang Dittus, later joined the staffs of STRI and the National Zoo's Department of Zoological Research.

With Richard Thorington of the Smithsonian's Museum of Natural History, Eisenberg took a census of the mammal species on BCI. Dr. Thorington later mapped the distribution of some of the island's trees, with help from NZP biologist Rudy

Surrounded by the waters of Lake Gatun, Panama's Barro Colorado Island has served as a haven for tropical biologists and wildlife alike since 1923.

Ironically, some of the same characteristics responsible for the sloth's staying power in the wild make these enchanting animals difficult to care for in captivity.

Rudran. Knowing when and where forest-dwelling animals search the lush vegetation for food would make it easier for scientists to target the territories of their subject species.

Sloth Survival

Evidence gathered in the fields is often vital to curators of highly specialized exotic animals. Arboreal folivores, for instance, are notoriously difficult to maintain in captivity; with this in mind, the National Zoo sponsored five years of research on the two- and three-toed sloths of Barro Colorado Island. In their pioneering studies of sloth ecology, Gene Montgomery and Mel Sunquist examined the complex network of pressures that determines the fate of these tropical mammals. The volumes of information gathered make it possible for scientists and visitors alike to see South American sloths "in action" at the Zoo today.

Even short-term survival is precarious for the sloth, Montgomery and Sunquist discovered. Due to the animal's extremely slow rate of digestion (food passage is measured in days rather than hours), a sloth could literally starve to death with a full stomach if it made a meal of the wrong type of leaves, or if midday sunlight were reduced or absent for several days. Different types of leaves are broken down at different rates, and some are simply absorbed too slowly; the rate of digestion also depends on the sloth's body temperature, which in turn depends on the amount of sunlight that reaches the animal.

"Social inheritance" in three-toed sloths was another fascinating trait the researchers explored. Not only does a mother sloth leave a section of her home range to her young, but each mother seems to teach her offspring a preferred "menu" for specific tree

species. Thus, while the home ranges of three-toed sloths may overlap, competition between the different sloth genealogies for food and living space is minimized.

By "packing" the forest with dense populations, sloths efficiently exploit their environment and compete favorably with other potential occupants of their niche. A comparison with the Old World tropics illuminates the sloths' evolutionary success: Whereas primate species occupy the corresponding Old World niche, the slow and steady sloths have become the most successful arboreal folivore of the New World tropics. Ironically, some of the same characteristics responsible for the sloths' staying power in the wild make these enchanting animals difficult to care for in captivity.

The Tests of Time

Thanks to careful conservation, Barro Colorado Island is ideal for long-term studies. Over the past 10 years, Charles Handley of Smithsonian's Museum of Natural History has conducted a comprehensive study of the island's bats. National Zoo scientist Katherine Ralls was a member of the 1976 start-up team which selected the study sites and developed capture techniques that would enable researchers to follow cohorts of bats through full reproductive and life cycles.

Former NZP intern Cindy Taft wrote a master's dissertation with data from a colony of Central American bats that Handley established at the Zoo. She visited the island during the course of her research and assisted in a study of frog-eating bats. The study found that these amazing mammals use the mating calls of male frogs to distinguish between edible and poisonous frog species. Even more

remarkable, the researchers discovered that the frogs adjusted their courtship behavior accordingly, with an entire pond falling silent at the approach of a single bat.

Exotic mammals are not the only animals of interest to biologists on the island. The fascinating behavior of tropical spiders, stick insects, and other invertebrates was studied for 18 years by National Zoo Director Michael Robinson. Before coming to NZP, Dr. Robinson conducted extensive research on Barro Colorado Island and later oversaw its operation as Deputy Director and Acting Director of STRI.

Bird specialists on the island have the best of both tropical worlds at their disposal: the protective outer shell of forest canopy and the dim, humid understory it shades. Research partners Judy Gradwohl and Russell Greenberg are engaged in a long-term study of migrant and resident birds; like their winged subjects, the researchers have been fortunate enough to make the journey from North America to Panama every year since 1977. Their project includes a yearly mapping of birds on a 12-hectare area. "We found that the territorial boundaries of certain species have remained the same for nine years, despite the frequent turnover of individual birds," said Greenberg. "This traditional land-tenure system is an example of how stable life in the rainforest can be."

While pursuing these studies, Greenberg and Gradwohl worked with NZP ornithologist Eugene Morton, who first visited Barro Colorado Island in 1964. Morton's major work in the mid-1970s addressed a perplexing question: Why had certain common mainland species become extinct on the island? Assisted by Guy Greenwell, then chief ornithologist at the

Zoo's Conservation and Research Center, Morton reintroduced populations of songwrens and white-breasted wood wrens to determine the causes of their decline and disappearance. The answer lay in the birds' specific habitat requirements; the island could not support high numbers of breeding pairs, and the nests, once built, were extremely vulnerable to predators.

Morton's project also furthered the development of reintroduction techniques, which are becoming increasingly important as zoos act to preserve endangered species.

The Endangered Habitat

FONZ support was instrumental in the recent success of STRI's iguana management program. During her year as a FONZ junior project assistant, Tracy Miller helped develop new husbandry techniques and participated in a dramatic hatch of hundreds of iguana eggs, the first ever in captivity.

Methods developed by Miller will benefit both wild and "ranch" green iguana populations, and may one day offer a breakthrough in tropical forest conservation efforts. Iguanas live in these rapidly disappearing forests, where they feed on tender treetop leaves. By establishing the green iguana, already prized as game meat, as a ready and easily grown source of protein for Latin Americans, program researchers hope to provide an incentive for "cropping" rather than clearing the forest, thus helping to preserve this rich and threatened habitat.

From iguanas to lianas (vines), the diversity of life on BCI is matched only by the diversity of the scientists who study it. Researchers emphasize that cooperation and collegiality between the normally separate disciplines sometimes leads to remarkable discoveries. "The chemistry is always changing," said Ted Grand, an anatomist who studied the adaptations of arboreal animals on BCI before coming to the National Zoo. "You'll have a botanist there, ornithologists, maybe someone who's interested in the way leaf-cutter ants break down cellulose. So you go to BCI to do your own project, but in fact, nobody talks about anything other than what *they're* working on, and then you all sort of trade. It's in that reverberation that everybody learns." □



Suspended 75 feet above the ground, researcher Cindy Taft explores the rainforest canopy.



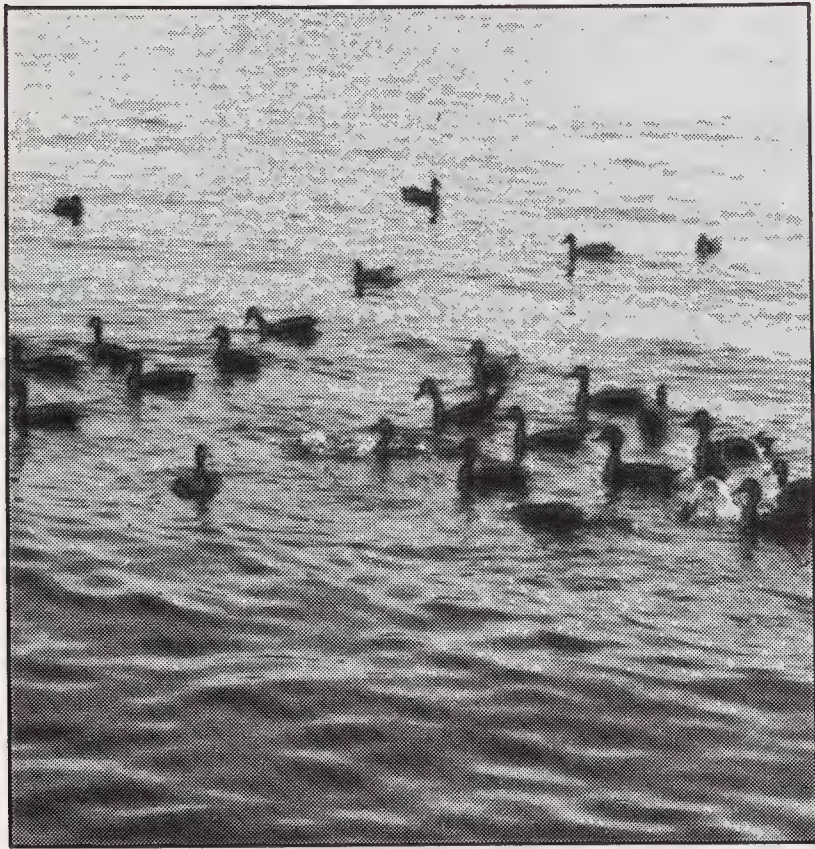
The silvery chrysalis of the Panamanian Adelpha butterfly reflects the diversity of insect life in the tropics.



An iguana emerges from the shell, one of more than 700 hatched en masse under the care of STRI scientists.

Baffling Black Ducks

Letty Morton



In autumn 1985, FONZ began funding a year-old study of mate choice and inbreeding in black ducks by researchers Cathy Blohowiak, Eugene Morton, Katherine Ralls, and Scott Derrickson at the National Zoo's Conservation and Research Center in Front Royal, Virginia. Although the research results are still very preliminary, and much more study is needed, the black ducks gave NZP scientists another lesson in how seldom animals behave the way people expect them to.

Cathy Blohowiak

Earlier in this century, great numbers of black ducks flocked along the Chesapeake Bay and East coast as far north as Labrador. But hunting and habitat destruction have caused black duck numbers to plummet in recent decades, and an influx of both stocked and wild mallards spreading east from the Midwest has made the situation worse. More adaptable to man-made changes in the environment, mallards compete with and often effectively crowd out black ducks from their remaining territories. The abundance of mallards poses a further threat to black duck survival as the two species can and do interbreed, a phenomenon that has given rise to a black duck-mallard hybrid that in turn competes with black duck populations for a share of dwindling resources. Indeed, while the black duck is not yet endangered in the wild, the combination of pressures may ultimately lead to its loss as a unique species.

Given this predicament (and the fact that individuals still can be taken from and returned to the wild without harming wild population levels), the black duck makes an ideal model for the study of reproductive behavior and genetics in bird species with small populations remaining in the wild—a

study which could lay the groundwork for a range of captive conservation programs. Specifically, the effects of inbreeding, an inevitable fact of life in small or isolated populations, can be tracked and used to answer questions vital to the success of a species' management in captivity. At what level does inbreeding affect the fitness of the animals; at what point in the reproductive cycle do the detrimental effects appear (in rates of fertility, hatchability, juvenile mortality, or elsewhere); and do animals avoid breeding with close relatives?

The old expression, "You can lead a horse to water, but you can't make him drink" certainly applies to black duck mating behavior. During a two-year study of these native waterfowl at the Zoo's Conservation Center, our research team paired off black ducks at random and found that fewer than a third of these pairs mated. Yet when the ducks were kept in large groups and allowed to select their own mates, a majority of them bred. What were the factors that determined their mate choice? When we began to tally our data, the results were utterly unexpected.

While many animal species exhibit social structures and behaviors that tend to minimize inbreeding, our captive black ducks did not. In the group we observed, many chose genetic siblings for a mate; most seemed actually to prefer those ducks familiar to them from their early social groups.

When ducks were placed together, either by combining families at hatch or at two months of age, the familiar ducks paired far more often with each other than with ducks introduced later during the courtship season. In contrast, of 12 observed pairings of wild black ducks, none were with siblings.

To learn what effect inbreeding has on the health and fertility of black ducks, we began to examine successively inbred captive generations. At first, the pairings from relatives had good levels of fertility, hatchability, progeny numbers, and viability compared with those from nonrelated pairs. But by the third or fourth generation, health problems started to appear in some of the highly inbred progeny, which are now being monitored for further evidence of inbreeding depression.

Our preliminary findings need to be incorporated into a long-term investigation so they can be replicated, extended to higher levels of inbreeding, and expanded to include more families before final conclusions are drawn and applied to other species.

In the meantime our study has provided a wealth of useful zoological data about black duck behavior, beginning with such basic observations as who sleeps next to whom, what they do when unfamiliar ducks are introduced into the group, and how they choose mates. We learned that mate selection in black ducks is carried out

Dr. Blohowiak is a Smithsonian Research Associate specializing in behavioral genetics.

by both sexes. Certain males in the group were avoided or threatened by pen-mates; others were preferred, with all the females acting like teenagers chasing after an idol. Males guarded their sisters from strangers, and groups of “friends” were formed which remained consistent throughout the two years of the study.

But our success was not limited to data-gathering. The first year of breeding studies produced so many offspring that the NZP research team had far more black ducks than the Conservation Center could accommodate. This provided a great opportunity to augment the small wild population of black ducks by releasing a substantial number of captive-bred ducks into the wild.

We proceeded with careful planning and caution. From previous small releases we knew that captive-bred black ducks are afraid of waves and boats, having never seen much more of the world than a plastic pool and jeeps. Therefore, the release itself should take place in an isolated area, with many hiding places and easy access to a main body of water. We found an ideal spot on Maryland’s Severn River and selected 60 ducks for the first release.

Our greatest thrill came at the moment of release, when the captive-bred animals took to their new environment like—ducks to water! We watched with pride as ducks which five hours before had been making mud puddles in their 60×60-foot pen and eating pellets out of a modified trash can began paddling along catching bugs and minnows or flying over sailboats.

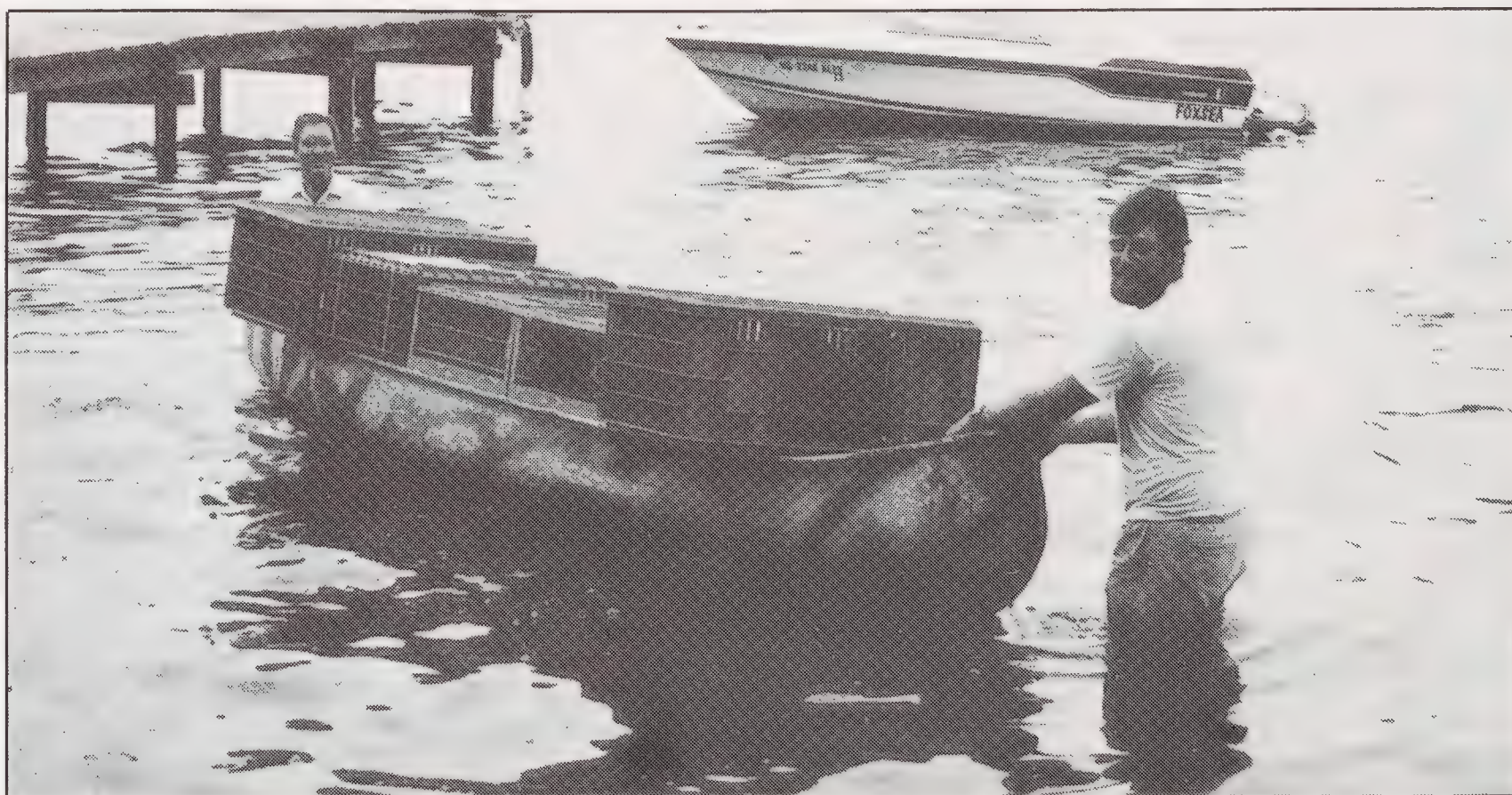
We continue to monitor our released ducks, encouraging them to stay near the release area by providing food on a sandy stretch of beach. Here it is possible to watch them closely, and even to see the numbers on their leg bands. We already know each captive-bred individual’s family and social group, and many of the ducks are so familiar to us that we recognize them right away. Our biggest reward came a year after the release, when we saw one of our females with a clutch of three ducklings—a good indication that these captive-bred ducks are capable of staying around the Bay, reproducing, and continuing to provide the Zoo’s research team with insights that can help in the effort to preserve this rare and fascinating species. □

Letty Morton



Before release, the ducks were banded so their lives in the wild could be monitored.

Letty Morton



Crated according to family or social group, the ducks rode in a canoe while the researchers waded through jellyfish-infested waters.

Letty Morton



Of the 60 ducks released on the beach, 40 were found to have remained in the area when researchers returned two weeks later.

Conserving Costa Rica

Howard Youth



During 1986, more than 100 Friends of the National Zoo participated in FONZ safaris to some of the world's most spectacular wild areas, from Australia's outback desert to the Amazon's steamy jungles. Virtually everyone who has joined one of these safaris has brought home far more than happy memories and stunning photographs—as this report from last year's FONZ trip to Costa Rica testifies.

Sally Tongren

Fix in your mind's eye the map of West Virginia. Now transform the eastern and western borders to coastlines, complete with sandy beaches and rocky headlands, reefs, and island where sea birds gather. Add a mountainous spine studded with volcanos, active and dormant, one of which reaches to 12,000 feet. Add farms and orchards, coffee plantations and palm nut groves, ranches where Brahmin cattle graze in floppy-eared tranquility and you begin to form an image of Costa Rica.

Now add forests. Imagine a cloud forest where massive trees reach to the sky. Although at first glance, the perpendicular lines and filtered light evoke the image of a great cathedral, the lasting impression is one of exuberant life. Ferns climb the buttressed tree trunks; mosses cling to the leaves; and vines descend from branches crowned by bromeliads and orchids.

And far above, where the sun breaks through the leaves, is a glory that no stained glass could equal: Three male resplendent quetzals flash past, long tails streaming, green feathers shining, scarlet breasts agleam, engaged in their courtship competition.

There are also lowland forests, their branches bare in the dry

season, the forest floor carpeted with fallen leaves. These crackle sharply when, startled at your approach, a large lizard leaps from one tree and dashes to another that seems to offer more security. The naked trees bear their blossoms in advance of the rainy season and this forest is full of flowers. Peccaries forage in the brush; scissor-tailed flycatchers dart out to nail a passing insect. As sunset approaches, dozens of these lovely birds pass overhead, perhaps beginning to gather for their northward migration.

Where the water table is within reach of tree roots, a taller, moister forest is home to spider monkeys. The troop retreats as you come near, then pauses to watch from a safe distance. But a big male remains to shake branches and, sometimes hanging by his tail, to pelt the source of the disturbance with any and everything at hand.

Yet another forest boasts white-faced capuchins and diminutive squirrel monkeys. Here, an agouti trots through the shrubbery; trogons and tanagers add sudden splashes of color; and in the twilight, a sloth gazes mildly down from a cecropia tree.

Such scenes are not uncommon in the tropics; probably they are what most of us would hope to see on a tropical visit. What is unusual about these scenes is that they are all occur within the protective confines of national parks. Costa Rica, no larger than West Virginia, with a population

of about 2,400,000, has established a park system that is a model for developing nations—and that could show us in the United States a few things about wildlife conservation. Approximately one-fourth of the country is protected by some sort of land use regulation, including forest reserves, watershed protection, Indian reserves, and archaeological sites; some 10 percent of this protected land is included in the system of national parks and biological reserves. Quite a record for a small nation.

The Costa Rican system is not without its problems. In any agricultural economy, money is a scarce resource. Although Costa Rica's economy is sounder than that of many Latin American countries, heavy demands—such as an ambitious social program—are placed on limited government funds. Further acquisition of wild lands may therefore depend on funding from private conservation groups outside the country. Yet, ironically, Costa Rica's conservation efforts to date have been so successful that it has some difficulty in obtaining private funds when needs are so acute elsewhere.

Then there are people problems. Costa Rica is not overpopulated to the same degree as some of its neighbors, but the annual growth rate is three percent, and the current population of two million will probably double before it levels off. With this growth, there is inevitably pressure for farm land.

A section has already been removed

FONZ volunteer Sally Tongren has authored several books and articles on zoo animals.

from the Palo Verde National Park, however a compromise, resulting from an interesting legal battle, saved a substantial area of park land: When the proposal was made that park lands be appropriated to grow sugar cane, the Association for the Conservation of Nature (ASCONA) took the President of Costa Rica to court. This precedent-setting action resulted in a decision that only the legislature could remove land from the park system once it had been placed under protection. Following this decision, a compromise was worked out: 5000 hectares are now being prepared for irrigation and new settlement will be established. ASCONA hopes to make good neighbors of the new settlers, minimizing conflicts over hunting and wood gathering. They plan to encourage handicrafts and possibly teach settlers to raise native animals such as the paca for food. There is also a potential for tourist business as the settlements border on the park and would be admirably located for tourist accommodation.

Conservation Education

Costa Rica is a country with a high literacy rate—over 90 percent—and no army. “We have a saying,” one citizen told me. “Our teachers are our army.” Included in their educational arsenal are lessons on the importance of Costa Rica’s natural diversity, starting in kindergarten and continuing through high school.

Conservation advocacy comes from other sources as well. The Monteverde Cloud Forest is a private preserve of the Tropical Science Center and owes its existence, in part, to the efforts of the community of American Quakers who settled in the area some 20 years ago. Over the years the Quakers have quietly but successfully campaigned in support of forest protection.

Recently, Daniel Janzen of the University of Pennsylvania, whose dedication to Costa Rican conservation is legendary, approached a group of settlers who were clearing land adjacent to the Santa Rosa Park with an offer to buy their land, an important area of original dry forest, for more than their purchase price. Would they, he asked, defer further clearing until he could raise funds? The settlers agreed. They knew about the importance of the forests from the lessons of the Quakers and the Costa Rican schools, so they were willing to delay clearing for a season.

The visitor to Costa Rica returns with a feeling of excitement about what has been accomplished, but wondering what the future holds. For all its internal stability, Costa Rica lies in a political hot spot. Can it maintain its neutrality? In order to support its growing population and standard of living, Costa Rica must produce agricultural products in quantity. There are certain to be intense demands for land, and as in all tropical

nations, research into appropriate, environmentally sound methods of forestry and agriculture is badly needed.

Increased tourism could become an important source of revenue. Tourists bring in a flood of foreign currency and providing their accommodation creates a substantial number of new jobs. The industry could provide funds and international support for the parks and further encouragement for conservation efforts. No matter how highly people value wildlife resources themselves, seeing those resources become a source of substantial income and employment can do nothing but increase their value.

But why worry? What has Costa Rica, or any other tropical nation for that matter, to do with you or me—or with our Zoo? It depends on your perspective. On the most altruistic level, perhaps it is enough just to know that there are protected places where the quetzal can still flaunt its resplendent streaming tail and the three-toed sloth can smile its “Mona Lisa” smile. Not all of us can go to see them, but it is satisfying to know they are there.

On a purely pragmatic level, good land management, protection of watersheds, concern for agricultural lands, and proper planning for the development of natural resources means hope for the future stability of one Central American nation, and this is assuredly something to be wished for.

Sally Tongren



Howard Youth



Costa Rica is trying to encourage agricultural development, like this cotton plantation (left), while also preserving its wildlife-rich forests (right).

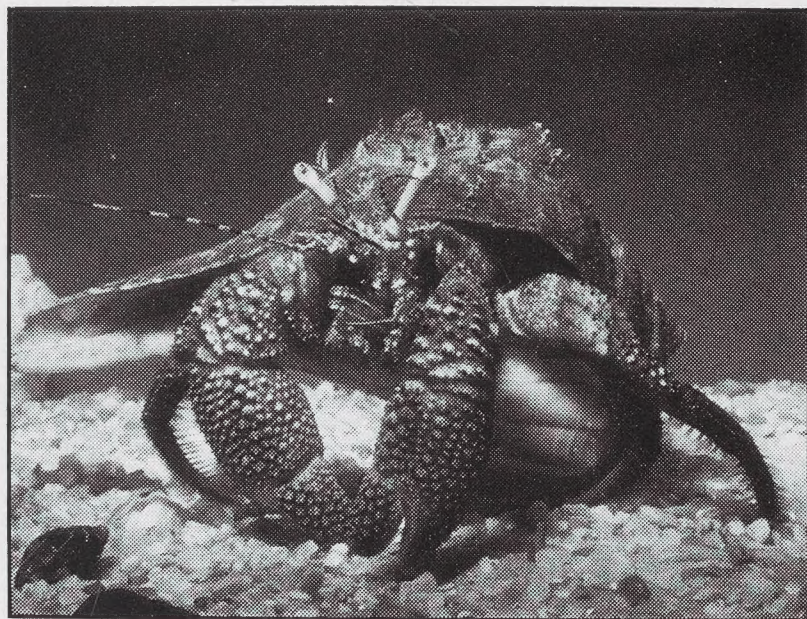


But there are other reasons for our interest and involvement. For bird watchers, Costa Rica is the winter home of many of our woodland birds. Wood thrushes, red-winged blackbirds, northern orioles, indigo buntings, vireos, and a whole host of wood warblers live in Costa Rica seven months a year, flying north to breed and become "ours" for a time. Blue-winged teal feed in Palo Verde's lagoons in company with shovelers and stilts, sandpipers and plovers and others of our familiar summer residents. Without the Costa Rican forests and marshes, we would no longer see these birds in our own.

A substantial number of tropical biologists receive part of their training in Costa Rica, and young Costa Ricans come to the United States for advanced education. There is a steady exchange of information and instruction between Costa Rican biologists and those from other parts of the world. Sunburned, back-packed foreign students tramp through the Monteverde forest or collect snakes at Santa Rosa, for the rich diversity of species of plants and animals forms a living laboratory. Some of these young people will be the future leaders in the drive not only to preserve natural diversity, but also to reap its benefits.

Finally, if we are interested in our Zoo and others, then we must feel a concern. No matter why we go to the Zoo—to show our children the elephants, to photograph, to sketch, simply to enjoy beautiful creatures—we bring away an impression of the diversity of life. To present a microcosm of this diversity is a major reason for a zoo's existence. When this diversity no longer exists in the wild, what does the zoo become but a zoological Williamsburg, a memorial to the life and beauty that once was, but that remains only in memory? □

Many North American shorebirds, like the spotted sandpiper (left), winter in Costa Rica and other parts of Central and South America. The fiery-billed aracari (center), a toucan species, travels in small flocks through the Pacific Slope forests of Costa Rica and Panama. The blue-crowned motmot (top), seen here near the Monteverde Cloud Forest Preserve, ranges from forests to suburban gardens. (Photos by Howard Youth)



Jessie Cohen, NZP Graphics

One of the most vulnerable crabs, the hermit crab seeks the protection of a series of empty shells throughout its life.

FOR MEMBERS ONLY

FONZ members are invited to a special members-only preview of the Zoo's new Invertebrate Exhibit May 1 and 2, 9 a.m. to 6 p.m., in the basement of the Reptile House. For free tickets, call 673-4960. Beginning May 7, the exhibit will be open to the public every Thursday through Sunday.

FONZ's volunteer office is currently training guides who will be on hand at the exhibit to conduct tours and answer visitors' questions. Those interested in becoming Invertebrate Exhibit guides should call Leslie Grumm, 673-4956.

TROPICAL NATURE

As the rate of tropical forest destruction increases, so does scientific recognition of the environmental consequences that result. Ultimately affecting temperate as well as tropical regions, the permanent transformation of lush forest into wasteland is slowly raising concern in this country.

Yet those newly alarmed by this distant devastation may have, at best, a fuzzy picture of the tropical Eden they are being urged to save. *Tropical Nature*, a collection of essays by Adrian Forsyth and Ken Miyata, goes a long way toward illuminating—and deepening—the mysteries of this all but unexplored realm. Subtitled "Life and Death in the Rain Forests of Central and South America," the book delivers a ringside account of the fiercely pitched biological battle that has resulted in a virtual explosion of tropical life forms.

Homing in on fine but telling details, the authors introduce major

ecological concepts by example: The sloths' sloth, a butterfly's "eyes," and the secret and none too passive life of plants offer a variety of keyholes through which the passing evolutionary parade may be glimpsed.

With essays ranging from "Hangers-On" to "Jerry's Maggot" (a true tale of life in the food chain that makes "Aliens" look inviting), the finely-tuned prose is as elegant as it is enticing. Cutting through a jungle of scientific jargon, Forsyth and Miyata reveal to the reader the "series of small miracles" that is both cause and effect of life in a timeless tropical world. (Published by Charles Scribner's Sons, New York. \$16.95/\$7.95.)

NEW AT THE ZOO

Two mouse deer (*Tragulus napu*), a species new to NZP, are on view in the Small Mammal House. The pair are at the National Zoo on loan from New York's Bronx Zoo. Native to Southern Asia, mouse deer have no horns or antlers in either sex; the males, however, grow long canine tusks.

Also new at the Zoo are an Oriental small-clawed otter cub in Beaver Valley, a newborn acouchi in the Small Mammal House, recently-hatched tegu lizards in the Reptile House, and three sugar gliders introduced into the nocturnal bat exhibit of the Lion-Tiger Building.

RESEARCH UPDATE

Zoological research is constantly turning up new information, opening new areas of investigation, and exploring unknown facets of exotic animal behavior, physiology, and health. The following research news items come from NZP scientists at the Zoo, in the field, and at the Conservation and Research Center in Front Royal, Virginia.

• A pilot program at the Zoo is raising hopes for the nearly extinct black-footed ferret. Using the closely related common European ferret as a model, NZP scientists artificially inseminated female ferrets and were rewarded last January with the birth of five cubs. With this success behind them, the scientists are now working to transfer the technique to the black-footed ferret. The species faces certain extinction unless the 20 or so

remaining animals breed, so artificial methods will provide a second chance if the animals fail to reproduce naturally in the coming season. "We will have this method ready for the black-foots in their next season," said NZP researcher David Wildt, "and will research other techniques, such as embryo transfer, over the next year."

• While gathering data on play behavior in sable antelope at the Conservation and Research Center, NZP Research Associate Kaci Thompson noticed that a dominant female in the herd had appropriated the calf of a subordinate female and begun rearing it along with her own calf. Such fostering is extremely unusual behavior in hoofed animals that are not closely confined, so Thompson's serendipitous discovery is exciting news to animal behaviorists.

• Why do some female monk seals exchange their pups before weaning? To what extent does this behavior affect the survivability of pups? In an effort to find the answers to these questions, and to gather other data on the Hawaiian monk seal, NZP scientist Daryl Boness has begun a study of this nearly extinct genus. Partially funded by FONZ, Dr. Boness' study will take place on French Frigate Shoals, a series of small, uninhabited islands on the Northwestern Hawaiian Island chain.

Mitchell Bush



Successful artificial insemination of the European ferret at NZP provides a model for the nearly extinct black-footed ferret.

**Spineless
Wonders
(p. 23)**



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